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COST AND METHODS OF CLEARING LAND IN THE LAKE STATES.

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INTRODUCTION.

Practically the entire northeastern part of Minnesota and all of Michigan and Wisconsin were originally forest land. Nearly all the southern parts of Michigan and Wisconsin are now cleared except for scattering farm wood lots. At the present time large areas of undeveloped land are found in northeastern Minnesota and the northern half of Michigan and Wisconsin. In Table I the figures showing the area of improved and unimproved lands were taken from the census of 1910; the statistics regarding the area of merchantable timber land and of logged-off land and the land values were compiled from data obtained from State, county, and township officials, lumber companies, and other companies or individuals well informed on these matters. The figures obtained furnish a fairly close approximation to the actual acreage of merchantable timber and logged-off land in the three States mentioned.

A part of the logged-off land in the three States specified probably would give better returns if put into permanent forest, but there is much good agricultural land in nearly every county in which these investigations have been conducted which at the present time is not growing desirable timber and is an idle waste (fig. 1), giving no returns whatever. Because of the danger from fire, these waste areas form a menace to the communities.

At the present rate of cutting, most of the remaining merchantable timber will be cut within the next 25 years. This means that in many counties there will be a change from lumbering to farming.

NOTE.—This bulletin gives details of cost and methods of clearing land in the Lake States and is of special interest to settlers in the logged-off sections of Michigan, Wisconsin, and Minnesota.

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TABLE I.—*Acreage of improved and unimproved lands, merchantable timber, and logged-off land and values of the improved and logged-off lands in the various counties of Michigan, Wisconsin, and Minnesota.*

State and county.	Acreage.				Value per acre.	
	Improved.	Unimproved.	Merchantable timber.	Logged-off.	Improved.	Logged-off.
Michigan:						
Alcona	38,037	399,723	3,000	327,700	$40 to $60	$5 to $15
Alger	5,634	583,157	375,000	125,000	30	6
Alpena	51,403	322,357	1,200	222,357	25	10
Antrim	78,810	225,190	16,000	179,190	60	10 to 15
Arenac[1]	55,571	183,789	.....	113,800	60	10
Baraga	9,344	577,536	297,280	240,256	75	7 to 25
Bay[1]	142,635	140,885	.....	45,100	100	15 to 25
Benzie	48,856	152,104	2,000	132,100	50	10 to 25
Charlevoix	61,587	201,463	16,000	175,400	40 up	10 up
Cheboygan	50,925	413,075	43,280	300,795	30	10
Chippewa	79,336	927,384	233,360	348,400	50 to 55	6 to 25
Clare[1]	53,921	318,559	.....	293,559	60	15
Crawford	10,701	357,299	15,000	320,000	35	8
Delta	42,932	705,228	150,000	450,000	40	10
Dickinson	8,342	488,298	174,397	269,846	75 to 100	3 to 25
Emmet	54,265	256,135	40,200	174,720	20 to 30	10
Gladwin	54,123	278,037	2,000	240,592	40	7 to 10
Gogebic	4,742	720,378	597,327	69,319	50 to 80	5 to 12
Grand Traverse	109,378	189,502	15,360	134,192	50	12
Gratiot[1]	248,899	121,661	.....	50,000	.....	.....
Houghton	35,921	616,239	217,200	299,040	50 to 75	10
Iosco[1]	40,735	324,065	.....	232,000	20 to 50	5 to 20
Iron	9,008	758,992	366,833	325,575	30 to 50	5 to 12
Isabella[1]	193,124	172,856	.....	122,800	60	10 to 15
Kalkaska	42,563	324,157	59,640	172,500	20 to 50	15
Kent[1]	365,717	184,683	.....	134,700	65	30
Keweenaw	1,236	353,324	253,324	50,000	15	5
Lake[1]	33,884	336,675	.....	296,700	30 to 50	10 to 15
Leelanau	83,812	132,508	7,000	89,300	30 to 70	15
Luce	7,926	580,874	125,000	225,000	50	6 to 20
Mackinac	21,118	647,042	173,440	374,400	40 to 60	5 to 15
Manistee	75,031	284,649	3,000	231,649	40	15
Marquette	23,041	1,173,759	500,000	550,000	25 to 50	8 to 15
Mason	100,925	215,235	2,000	144,000	50	12 to 15
Mecosta[1]	159,794	205,646	.....	23,080	50	10 up
Menominee	64,590	611,250	138,338	372,912	50	3 to 15
Midland[1]	94,717	243,843	.....	174,800	75 to 100	10 to 15
Missaukee[1]	60,918	311,562	.....	211,500	20 to 50	5 to 20
Montcalm	266,401	196,959	3,000	175,000	60 to 100	15
Montmorency	17,506	341,534	42,200	161,500	.....	.....
Muskegon[1]	109,656	212,904	.....	152,900	35 to 70	3 up
Newaygo[1]	166,072	378,568	.....	240,600	25 up	10 up
Oceana	151,782	195,738	8,500	179,900	50 up	2.50 to 25
Ogemaw	55,437	315,763	2,000	260,800	40 to 50	10
Ontonagon	11,992	841,128	510,000	300,000	25 to 50	3 to 10
Osceola	129,303	239,977	1,760	215,900	50	20
Oscoda	16,218	352,422	10,000	296,400	25 to 50	10 to 15
Otsego	27,627	310,293	70,840	196,500	20 to 40	8.50 to 15
Ottawa[1]	247,236	114,364	.....	75,200	60 to 70	30 up
Presque Isle	39,925	393,995	9,960	245,800	30 to 35	10
Roscommon	8,951	335,369	30,000	245,000	25 to 50	7.50 to 25
Saginaw[1]	304,738	225,182	.....	72,200	.....	.....
Schoolcraft	15,431	757,049	100,000	400,000	30 to 75	5 to 15
Wexford	79,044	290,236	33,960	226,000	25 up	5 to 12.50
All other counties[1]	8,561,259	3,304,621	.....	.....	.....	.....
Total	.....	.....	4,587,261	11,954,628	.....	.....
Wisconsin:						
Ashland	24,400	668,000	150,000	450,000	50	3 to 35
Barron	170,203	396,197	3,000	400,000	20 to 60	10 to 15
Bayfield	21,700	940,200	200,000	600,000	60 to [2]150	3 to [2]100
Burnett	56,600	493,800	15,000	265,000	50	10 to 20
Chippewa	196,000	468,900	46,800	315,600	40 to 50	12 to 20
Clark	151,900	627,600	1,250	625,000	50 to 100	6 to 10
Douglas	19,900	835,800	22,000	700,000	20 to 35	5 to 10
Dunn	245,100	311,100	1,000	300,000	20 to 35	5 to 10
Eau Claire	185,861	223,459	2,000	113,000	20 to 50	7 to 20
Florence	8,500	309,600	93,500	202,200	50	4 to 10
Forest	6,100	889,900	335,085	490,800	50	10
Iron	3,900	503,000	165,000	335,000	75 to 100	3 to 25
Langlade	47,800	512,200	240,000	250,000	25 to 60	3 to 20

[1] The only timber in the county is in farm wood lots.

[2] Orchard land.

TABLE I.—*Acreage of improved and unimproved lands, merchantable timber, and logged-off land and values of the improved and logged-off lands in the various counties of Michigan, Wisconsin, and Minnesota*—Continued.

State and county.	Acreage.				Value per acre.	
	Improved.	Unimproved.	Merchantable timber.	Logged-off.	Improved.	Logged-off.
Wisconsin—Continued.						
Lincoln	33,550	543,730	203,000	307,000	$40 to $80	$8 to $20
Marathon	184,150	810,410	86,500	700,000	25 to 60	10 to 20
Marinette	79,474	826,126	210,000	575,000	20 to 60	5 to 10
Oconto	134,000	581,500	125,000	110,000	40 to 60	3 to 15
Oneida	17,700	558,900	37,000	485,000	30 to 60	5 to 12
Pepin	70,175	80,865	1,000	2,500	25	10
Polk	149,600	448,800	15,000	225,000	40	12
Portage	218,149	301,530	7,500	197,500	25 to 50	5 to 10
Price	23,100	795,500	180,480	500,000	25 to 60	6 to 15
Rusk	25,900	566,100	90,000	400,000	50 to 100	9 to 20
Sawyer	10,400	834,400	225,000	550,000	50	5 to 25
Shawano	170,200	370,900	211,600	185,000	30 to 40	8 to 10
Taylor	33,900	600,300	200,320	300,000	40 to 60	10 to 20
Vilas	4,600	528,500	85,000	350,000	30 to 60	5 to 12
Washburn	41,600	492,800	18,000	365,000	20 to 70	5 to 15
Waupaca	221,248	264,512	1,250	97,500	25 to 60	10 to 20
Wood	108,000	409,800	1,000	396,000	50 to 75	8 to 20
All other counties	9,243,896	7,060,800	(1)			
Total			2,972,285	10,792,100		
Minnesota:						
Aitkin	34,750	1,136,450	100,000	800,000	40 up	5 to 10
Anoka	101,575	192,000	1,200	110,000	30 to 90	15 to 30
Becker	178,892	684,468	200,000	450,000	30 to 60	10 to 30
Beltrami	33,253	2,413,000	500,000	1,350,000	20 to 60	6 to 15
Benton	108,847	150,000	22,500	110,000	35 to 100	15 to 30
Carlton	27,518	527,362	10,000	510,000	50 up	10 up
Cass	40,262	1,300,000	300,000	900,000	25 to 75	5 to 16
Chisago	104,670	168,600	15,000	112,000	20 to 50	10 to 20
Clearwater	40,000	612,000	60,000	400,000	20 to 40	5 to 15
Cook	1,568	957,152	450,000	[2] 350,000		
Crow Wing	51,989	624,491	165,000	410,000	20 to 30	10 to 15
Hubbard	55,699	557,400	75,000	400,000	20 to 30	3 to 5
Isanti	109,642	173,246	1,200	100,000	20 to 50	10 to 20
Itasca	13,636	1,733,600	510,000	1,050,000	40	10
Kanabec	37,370	304,400	18,000	278,000	15 to 100	10 to 30
Lake	2,381	1,341,000	500,000	600,000		
Mahnomen	24,123	341,967	95,000	200,000	30 to 60	10 to 30
Marshall	380,677	763,600	32,500	50,000		
Mille Lacs	48,438	324,682	30,000	283,000	35 to 100	15 to 30
Morrison	184,150	547,370	20,000	450,000	25 to 40	10 to 15
Otter Tail	592,598	712,362	250,000	200,000		
Pennington	136,735	252,000	None.	[3] 60,000		
Pine	64,768	839,552	125,500	640,000	50	8
Polk	643,946	622,614	10,000	[3] 100,000		
Red Lake	77,138	199,342	3,000	[3] 25,000		
Roseau	157,332	911,000	60,000	350,000	20 to 60	5 to 20
St. Louis	41,111	4,120,809	300,000	1,200,000	40 to 50	5 to 25
Sherburne	110,927	175,793	1,000	[3] 100,000	40 to 90	15 to 40
Wadena	69,703	274,617	40,000	180,000	20 to 40	8 to 15
All other counties	16,169,835	9,164,710				
Total			3,894,900	11,768,000		

SUMMARY.

Classification.	Michigan.	Wisconsin.	Minnesota.
	Acres.	*Acres.*	*Acres.*
Approximate land area	36,787,200	35,363,840	51,749,120
Improved land	12,832,078	11,907,606	19,643,533
Unimproved land	23,955,122	23,456,234	32,105,587
Merchantable timber	4,587,261	2,972,285	3,894,900
Logged-off land	11,954,628	10,792,100	11,768,000

[1] Wood lots only. [2] Large burns. [3] Brush land.

The clearing and management of the logged-off lands is the most pressing problem in most of these counties. The object of the investigations conducted by the Office of Farm Management has been to obtain data from which to acquaint the public with the large areas of undeveloped land in these sections and the nature of the work necessary to make them available for agricultural purposes. A study has also been made of all the different conditions of clearing and the best methods practiced in the different sections, with the object of combining the best practices into a system or number of systems of clearing adapted to the region.

FIG. 1.—Characteristic stump land in the Lake region.

At the present time very little logged-off land that would make desirable farm land can be bought for less than $15 to $25 per acre. As the cost of clearing varies from $20 to $90 per acre, the cost of farm land cleared of stumps will run from $35 to $115 per acre, the average being about $65. When the cost of other necessary improvements is added to this, it makes the ultimate cost of an improved farm higher than the price of equally as good a farm in many of the older, well-settled agricultural sections of the United States. The high price of the logged-off land and the high cost of clearing seriously retard its development.

The methods given in this bulletin, while extensively used, are not necessarily the best possible. There is plenty of room for improvement in all the methods now practiced.

METHODS OF CLEARING.

All methods of clearing have to deal with the removal of the stumps, brush, and second growth. In a few localities the second growth can be disposed of to charcoal and wood-extract companies, to mining companies (for use as ties and timbers), to wood-pulp mills, or for use as fuel for enough to pay for its removal. It usually does not pay, however, to haul the wood more than 4 or 5 miles. In most cases the second growth (fig. 2) has no value except as firewood for the use of the settler, and its removal must be considered an expense of clearing.

FIG. 2.—Typical logged-off land of the Lake region.

It is cheapest to cut the brush as soon after logging as possible. It should be cut close to the ground when in full leaf, heaped into compact piles, and burned as soon as it will burn well. The best time for burning is during the summer. On account of the danger of the fire spreading at this time, the local or State fire warden should be consulted and a permit obtained from him before any burning is attempted.

Some make a practice of harrowing or disking the ground immediately after burning and then sowing timothy seed. The following spring, as the frost leaves the ground, clover seed is added. Others sow all the grass seed in the spring. Where possible it is a good plan to leave the land in pasture or meadow several years before removing any stumps. (Fig. 3.)

On hardwood land the cost of removing green stumps is much more than that of removing similar stumps that have decayed for six or seven years. In the case of pine stumps growing in the heavier

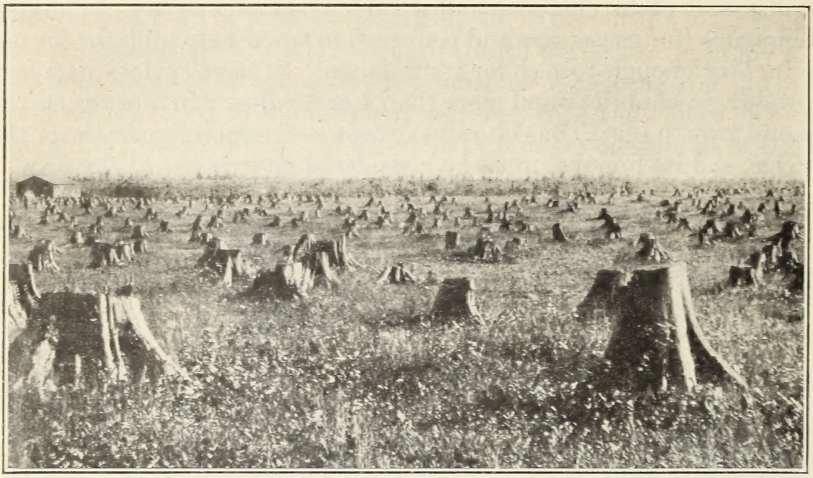

FIG. 3.—Stump land that has been pastured for several years.

soils, the settling of the land and the heaving action of the frost gradually work the stumps out of the ground, so that the expense of removing them will be somewhat less where the land has been in grass several years. (Fig. 4.) A serious drawback to leaving the

FIG. 4.—Blasting stumps from land that has been in pasture for several years.

land in grass without stumping is the sprout growth. To keep down this sprout growth requires persistent work for several years. Sheep and goats have been used successfully in some localities, but the dairy herd has taken the place of nearly all the flocks and is considered more profitable.

In cultivating a field covered with stumps, it is impossible to use modern farm machinery efficiently. Stumps are removed (1) by explosives alone, (2) by explosives used in connection with stump pullers or block and line, (3) by stump pullers alone, and (4) by power machines.

EXPLOSIVES.

Explosives alone are used effectively and economically in all stumping operations on the heavier soils and for well-decayed hardwood stumps on the lighter soils. They have the advantages of thoroughly breaking up the stumps, of not requiring a large force of men for clearing operations or a large cash outlay at one time, and of enabling the work to be done quickly. The rather high cost of explosives when bought in small quantities and the fact that only experienced men should handle them are their chief drawbacks. Direct cooperative buying in wholesale lots will reduce materially the cost of the explosives.

Satisfactory instructions [1] regarding the use of explosives are now published by practically all manufacturers. The chief faults of the average man in blasting stumps are his tendency to place the charge too shallow and his failure to put it under the center of resistance of the stump.

On most of the land-clearing operations in Michigan dynamite containing 40 per cent of nitroglycerin or its equivalent is used. In a few sections dynamite containing 20 to 30 per cent of nitroglycerin or its equivalent has been used with very satisfactory results. On the Pacific coast 20 per cent nitroglycerin dynamite or its equivalent is used almost exclusively. Dynamite containing the smaller percentages is cheaper, less dangerous to use, and does not pack the soil to such an extent as the stronger preparations. On the heavier soils the lower strength explosives will give just as good results pound for pound as the higher. The lower strengths act more slowly, with much less shattering, and have almost the same lifting force as those containing higher percentages of nitroglycerin.

It is commonly believed that dynamite with 60 per cent of nitroglycerin is twice as effective as that with 30 per cent and that that with 40 per cent of nitroglycerin has twice the effectiveness of 20 per cent. Tests by the United States Bureau of Mines [2] have demonstrated

[1] Valuable information regarding the proper use of explosives in stumping may be found in the following publications:

McGuire, A. J. Land clearing. University of Minnesota Agricultural Experiment Station, Bulletin 134, 32 p., 21 fig., 1913.

Kadonsky, J. F. The use of explosives in clearing land. University of Wisconsin Agricultural Experiment Station, Bulletin 216, 19 p., 20 fig., 1911.

Thompson, Harry. Cost and methods of clearing land in western Washington. U. S. Department of Agriculture, Bureau of Plant Industry, Bulletin 239, 60 p., 25 fig., 1912.

[2] Hall, Clarence, and Howell, Spencer P. The selection of explosives used in engineering and mining operations. U. S. Department of the Interior, Bureau of Mines, Bulletin 48, 50 p., 3 pl., 7 fig., 1913.

that the propulsive or lifting force of 60 per cent "straight" nitroglycerin dynamite is only 18.7 per cent more than that with 30 per cent. On the other hand, its disruptive or shattering force is 42.5 per cent more. Carefully conducted field tests in stump blasting have shown that the propulsive or lifting effect of 40 per cent nitroglycerin dynamite is but little more than that of 20 per cent, while the disruptive or shattering effect of the 40 per cent is considerably more than that of the 20 per cent preparation. In stump blasting a high propulsive force and a comparatively low disruptive effect are desirable. For this reason ammonia dynamite (powders containing some ammonia and branded "extra") and powders containing no nitroglycerin, because of their slower action and consequent low

FIG. 5.—Capstan stump puller. This type requires an anchor stump from which all stumps within a radius equal to the length of the pulling cable can be pulled.

disruptive effect, are generally to be preferred to the straight nitroglycerin powders. In case the lower nitroglycerin powders or their equivalent are employed, No. 6 or stronger caps should be used.

STUMP PULLERS.

Two types of stump pullers are used—those that pull from the side, as the capstan (fig. 5), and the tripod type, which lifts the stump vertically (figs. 6 and 7).

THE CAPSTAN TYPE OF MACHINE.

The capstan type has the advantage that an acre or more of stumps can be pulled at a single setting. In pulling small stumps like scrub oak, jack pine, and certain kinds of hardwood, the saving in time is

quite an item. In pulling small, sound stumps considerable time is saved in not having to dig root holes, which are necessary when using a tripod type of machine. With large stumps which are partly decayed, this saving of time over that required in the use of the tripod type is about offset by the loss of time due to stumps breaking off. When this occurs, each large root must be dug and pulled out separately. The capstan machine will work on steeper land than the tripod, though no machine will do very satisfactory work on a steep hillside. By using the double and triple power arrangements of lines, the capstan machines will pull any white-pine stump in the Lake States. Many practical land-clearing operators using the capstan machines do not favor the use of the double or triple power in connection with these machines because of the time lost in adjusting the blocks and hauling the extra cable. They prefer to use a small quantity of dynamite under the larger stumps to split and loosen them. With the tripod type of machine the use of dynamite to loosen the stump is unnecessary, because these machines are powerful enough to pull any white-pine stump.

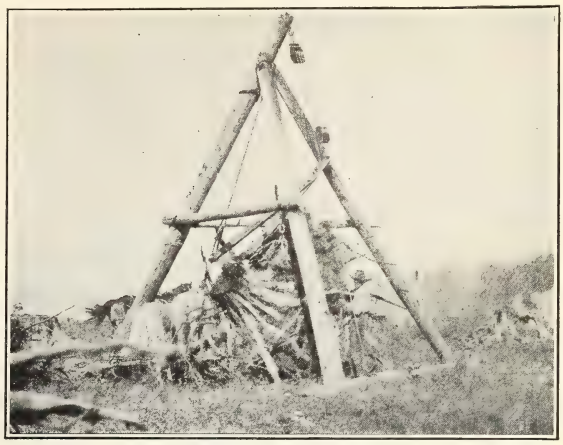

FIG. 6.—Typical tripod stump puller. Pullers of this type must be set directly over each stump pulled.

FIG. 7.—Another stump puller of the tripod type.

THE TRIPOD TYPE OF MACHINE.

Many stumping contractors clearing white-pine land in Michigan use the tripod type of machine. Any stump pulls more easily when lifted vertically than when pulled from the side. No anchor stump

is required with this type. The vertical-lift machines are more powerful and seem to require less repairs than the average capstan machine. On the other hand, the machine must be moved for each stump, requiring four or five horses. Holes must be dug under the roots of each stump.

POWER MACHINES.[1]

Power machines have been used to a limited degree throughout this region. On large tracts of land, with a good outfit and an efficient crew, the clearing probably can be done with a power machine as cheaply as and considerably faster than by any other method in use at the present time.

COST OF CLEARING LAND.

The cost of clearing land in the Lake States varies greatly. It runs from $5 to about $100 per acre. The cut-over jack-pine land is the cheapest to clear and green hardwood and unburned swamp land the most expensive. The cost of clearing depends on the following factors:

(1) The quantity of second growth and logs per acre: The cost of disposing of these runs from $5 to $25 per acre, and even higher, with an average of about $10.

(2) The kind of stumps and the number of years since logging: All green hardwood stumps are very expensive to remove. Green birch and basswood are perhaps the most difficult. Most hardwoods decay so that they can easily be removed within 10 years from the time of logging, provided the sprout growth is not allowed to develop. Jack pine and hemlock will decay at about the same rate as hardwood. Scrub oak is more resistant to decay than the other hardwoods. White pine and Norway pine will not decay in 50 years. The cost of removing pine stumps from 5 years to 25 years after logging is practically the same.

(3) The size and number of stumps per acre: The number of white-pine stumps per acre varies from 10 to 100, with an average of about 45. Some hardwood lands have more than 400 stumps per acre. Some contractors taking work by the job count the stumps and then add 10 per cent to the number to cover those that were overlooked or burned close to the ground. It usually is more expensive to remove severely burned white-pine stumps than it is to remove a sound stump. For this reason any system of burning that will not burn the roots below plow depth does not reduce the cost of stumping. A pretty close approximation of the average number of stumps per acre may be obtained by counting the number of stumps on several sample acres. A circle of 117.8 feet radius contains an area of 1 acre. A rapid and convenient method is to stand on a stump and count all the stumps within 118 feet of it.

(4) Soil and topography: Where stump-pulling machines are used, the cost of stumping in sandy soils is less than in heavier soils. Where dynamite is used, the cost in heavier soils is less than in sandy soils. On many tracts the land was swampy at the time of the tree growth, and the rooting system was consequently shallow. After the tract shown in figure 8 was logged, fires burned off all the litter and most of the humus, leaving nearly all of the roots exposed. On many such areas a heavy team will tip out most of the stumps by a direct pull. For this reason this type of clearing is not usually expensive. (See "Tract No. 20," p. 22.) It is more expensive to pull stumps on steep land than it is on level land. It is more expensive to stump stony land than land free from stones, because the cleaning of the stumps is more difficult.

[1] See Thompson, Harry, Cost and methods of clearing land in western Washington, U. S. Department of Agriculture, Bureau of Plant Industry, Bulletin 239, 60 p., 25 fig., 1912, for use of power machines for land clearing.

(5) Size of area to be cleared and proximity to other clearings: Stump-pulling machines will usually reduce the cost of clearing, but it is not economical to buy one for the clearing of a small tract. Explosives cost considerably less when bought in large quantities. In a locality where much clearing is being done it may be possible to cooperate in the purchase of stump pullers and explosives, and experienced help can be hired cheaper in such a region.

Table II gives an approximate idea of the cost of clearing white-pine land in this region. Additional data of the conditions of clearing

FIG. 8.—Swampy lands of the Lake region that have been burned over, showing the shallow rooting system.

on the 16 tracts summarized in this table, as well as details of the clearing of several additional tracts, are given in the pages which follow.

TABLE II.—*Approximate cost of removing stumps on 16 tracts of white-pine land, compiled from records kept during actual operations.*

Tract.	Acres.	Stumps.			Soil and subsoil.	Method.	Cost, including labor.				
		Number.	Average diameter (inches).	Average number per acre.			Pulling.[1]		Total.	Per acre.	Per stump, including disposal.
							Contract.	Actual.			
No. 1	40	2,000	20.2	50	Sandy	Explosive			$925.20	$23.13	$0.463
No. 2	3	297	18–36	99	do	do			258.00	86.00	.86
No. 3	7	334		48	Clay	do			200.00	28.57	.60
No. 4	24.21	290	19.85	12	Sandy	Capstan		$0.259	145.00	5.99	.50
No. 5	50	1,018	22	20	Sandy loam [2]	do		.372	698.91	13.98	.686
No. 6	1	78	18.6	78	Sandy	do		.144	25.65	25.65	.329
No. 7	60	2,464	24.6	41	Clay	Tripod	$0.32	.26	1,444.00	24.07	[3].586
No. 8	30	2,464	24	82	Sandy loam	do	.19	.102	868.00	28.93	[3].352
No. 9	30	2,000	28	67	do	do	.25	.105	710.00	23.67	[3].355
No. 10	46	1,812	28.6	39	Silt and clay	do	.35	.32	1,283.82	27.91	[3].71
No. 11		1,319	28.6		do	do		.465	1,063.87		[3].806
No. 12	40	2,400		60	Sandy	do	.18	.14	768.00	19.20	[3].32
No. 13	20	1,293	23.2	65	do	do	.387		500.00	25.00	[3].387
No. 14	7.4	204	26.77	28	Sandy loam	do	.50	.563	184.93	25.06	.907
No. 15	40	3,600		90	Sandy	do	.25	.25	900.00	22.50	[3].25
No. 16	35	1,050		35	do.[2]	do	.333		700.00	20.00	.666

[1] The operation of "pulling" includes getting the stump out of the ground, cleaning the dirt from its roots, and leaving it where it will not settle back into the ground.

[2] Clay subsoil.

[3] Tracts Nos. 7 to 13 and 15 were stumped by experienced contractors, who were well equipped and employed experienced men with heavy teams accustomed to the work. The average landowner can not safely figure on getting his stumps pulled for less than these contract prices.

TRACT NO. 1.

Tract No. 1 contained 40 acres of level land. The soil to root depth varied from medium to fine sand. The blasting was done in the spring of 1913 at a time when the ground was wet. The tract was logged 32 years before. Since that time it had been burned repeatedly, and there was no undergrowth. The tract averaged 4 or 5 small logs per acre. Of the stumps on the tract 16 per cent were so severely burned that it was necessary to partially dig the roots out and pull them with a team. The average number of stumps per acre was 50, of which 20 per cent were Norway pine and 80 per cent were white pine. The diameter of the stumps at the cut-off varied from 6 to 30 inches, the average being 20.2 inches.

The owners of this tract had recently purchased a capstan stump puller. With an inexperienced crew the cost of pulling and disposing of the stumps, as shown in Table III, was practically the same as with dynamite.

TABLE III.—*Cost of labor and material in clearing an acre of tract No. 1.*

Item.	Days employed.	Cost.	
		Per diem.	Total.
Blasting stumps:			
1 powder man	1	$2.00	$2.00
Dynamite, 75 pounds at 13 cents			9.75
Caps and fuse			1.13
Pulling roots and piling and burning stumps:			
3 men, 1 day each	3	1.75	5.25
1 man with team	1	5.00	5.00
Total cost per acre			23.13
Total cost per stump			.463

TRACT NO. 2.

Three acres of pasture land having a sandy soil, containing 297 white-pine stumps 18 to 36 inches in diameter, were blasted by the use of 1,200 pounds of powder containing no nitroglycerin. This is an average of 43 cents per stump, including the cost of labor for doing the powder work. The cost of piling and burning is equal to the cost of blasting, which makes an average of 86 cents per stump and approximates $86 per acre.

TRACT NO. 3.

Seven acres containing 334 white-pine stumps upon pasture land having a clay soil were blasted, piled, and burned at a cost of $200, an average of 60 cents per stump and $28.57 per acre.

TRACT NO. 4.

Tract No. 4 contained 24.21 acres of level land having a sandy-loam soil within root depth and practically no stones. The outfit used was a capstan stump puller, with 200 feet of 1-inch cable on a drum and an additional length of 150 feet of 1-inch cable, giving the

machine a pulling radius of nearly 350 feet. The other tools used were 15 feet of 1¼-inch double-power cable, 14 feet of 1⅛-inch cable, shovels, axes, a bar, and a mattock.

The pine of the tract had been logged about 30 years ago. The hardwood had been cut off seven or eight years ago, except where noted. The hardwood stumps were so rotten that they were very easy to remove. The tract had been burned repeatedly since logging. Scarcely any vegetation or sod was left to retard the work of cleaning the soil from the stumps. There was a very scattering growth of poplar and bird cherry, averaging about 3 feet in height on the tract. Included in the 290 stumps were 76 "snags"—stumps that had been burned close to the ground, leaving the roots in the ground. These snags are fully as hard to remove as the average stump. The stumps were piled later in the year by means of a gin pole. Details as to the kinds and sizes of the stumps and particulars relative to the cost of stumping are given in Table IV.

TABLE IV.—*Stumps pulled and cost of labor and material used on tract No. 4.*

KINDS AND SIZES OF STUMPS.

Kind of stumps.	Diameter of stumps (inches).																Total number of stumps.
	4	6	8	10	12	14	16	18	20	22	24	26	28	30	34	36	
	Number of stumps:																
White pine	....	1	....	1	1	4	8	16	30	16	19	15	14	17	1	6	149
Norway pine	....	....	....	....	....	1	1	2	5	2	2	1	....	....	....	....	14
Beech	....	3	2	2	4	....	....	....	....	....	....	....	....	....	....	....	11
Maple	1	2	3	7	1	1	....	....	1	....	....	....	....	....	....	....	16
Hemlock	....	1	6	1	6	3	....	....	....	....	....	....	....	....	....	....	17
Birch	....	1	....	....	1	....	....	....	....	....	....	....	....	....	....	....	2
Scrub oak	....	....	....	....	1	1	....	....	....	....	....	....	....	....	....	....	2
Poplar	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Green hard maple	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	1
Green white pine	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Total	1	8	11	12	15	11	9	18	36	18	21	16	14	17	1	6	[1] 214
Number of snags	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	76
Total for 24.21 acres	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	[2] 290

LABOR AND MATERIAL USED IN STUMPING. [3]

Item.	Days employed.	Cost.	
		Per diem.	Total.
Crew:			
2 machine men, 6 days each	12	$1.75	$21.00
2 men to clean stumps, 6 days each	12	1.75	21.00
1 team and teamster	6	4.00	24.00
Use of machine	6	1.50	9.00
Piling and burning (estimated)	....	....	70.00
Total	....	....	145.00
Average per acre	....	....	5.99
Average per stump	....	....	.50

[1] Average diameter of the 214 stumps, 19.85 inches.
[2] Average number of stumps per acre, 12.
[3] Time of clearing, 6 days, July 28 to Aug. 4, 1913.

The average height of the pine stumps was 33 inches. The average number pulled each day was 48. The cost of pulling, cleaning, and tipping was 25.9 cents per stump. Dynamite had been used in stumping this land, but because of the loose nature of the soil it had proved too expensive.

FIG. 9.—Device for piling stumps.

TRACT NO. 5.

Tract No. 5 contained 50 acres of very gently rolling pasture land with sandy-loam soil and clay subsoil. The outfit consisted of a capstan stump puller, shovels, axes, and bars. The stumps were piled by the device shown in figure 9. Details of the cost of removing 1,018 stumps from this field are given in Table V.

TABLE V.—*Cost of stumping tract No. 5.*

Item.	Days employed.	Cost.	
		Per diem.	Total.
Pulling stumps:			
1 man	45	$1.75	$78.75
1 man	3	1.75	5.25
1 man with team	45	4.50	202.50
Use of stump puller	45	1.50	67.50
Dynamite, 200 pounds, at 12¾ cents			25.50
Caps and fuse			1.41
Piling and burning stumps:			
3 men with teams, 20 days each	60	4.50	270.00
1 man	20	1.75	35.00
Use of stump piler	20	.75	15.00
Total			698.91
Average per acre			13.98
Average per stump			.686
Average per stump for pulling			.372
Average per stump for piling			.314

The pulling was done in 45 days, an average of 23 per day. The average number of stumps per acre was about 20. This tract was logged 30 years ago. Fires had kept down all underbrush. All logs had been removed. The rooting system of the stumps was shallow. In burning, the stumps were placed about 50 in a pile. They were set on fire at night, and usually the following morning the unburned stumps were repiled. The sizes of 87 white-pine stumps measured

on this tract were as follows: 16-inch, 7; 18-inch, 12; 20-inch, 18; 22-inch, 17; 24-inch, 16; 26-inch, 10; 28-inch, 4; 30-inch, 2; 32-inch, 1. The average diameter was 22 inches and the average height 33 inches.

On a neighboring tract, similar in all respects, the stumps were pulled and cleaned under contract for 40 cents each. Here three men with a light team, using a capstan machine, pulled an average of 20 stumps a day. The man for whom the stumps were pulled under contract formerly used dynamite of 40 per cent strength and pulled the remaining roots with a team, using a block and line. He also tried heavy blocks and line. All these methods were found less satisfactory than a contract at 40 cents per stump. In piling stumps the device shown in figure 9 was used, and with the same crew an average of 50 stumps a day was piled.

TRACT NO. 6.

Tract No. 6 contained 1 acre of level land, having a loose, sandy soil. It was cleared in August, 1913. The outfit used was a capstan stump puller. At the time of tree growth this tract was wet; as a result the stumps were shallow rooted. The tract was logged about 35 years ago. Repeated fires since that time had burned off the litter until the roots of the stumps were well exposed, and there was practically no undergrowth or logs on the tract. The sizes of 62 white-pine stumps, selected at random and measured on this tract, were as follows: 12-inch, 4; 14-inch, 8; 16-inch, 9; 18-inch, 12; 20-inch, 11; 22-inch, 9; 24-inch, 9. The average diameter was 18.6 inches and the average number per acre was 78.

The low cost per stump of clearing this tract, as shown in Table VI, was due to the small size of the stumps and to the fact that the rooting system was very shallow. On this farm the actual cost of clearing over a hundred acres of land has been $39.30 per acre. About 50 per cent of this land is as described above. The remainder is low, wet, sandy land with cedar, tamarack, and occasional white-pine or Norway-pine stumps. The average number of stumps per acre was about 12, and their average diameter was about 10 inches.

TABLE VI.—*Cost of clearing tract No. 6.*

Item.	Days employed.	Cost.	
		Per diem.	Total.
Pulling stumps:			
3 men	1	$1.75	$5.25
1 team	1	4.50	4.50
Use of stump puller	1	1.50	1.50
Piling and burning stumps:			
2 men	1.2	1.75	4.20
1 team	1.2	4.50	5.40
Repiling stumps (time estimated):			
2 men	.6	1.75	2.10
1 team	.6	4.50	2.70
Total per acre			25.65
Total per stump			.329

Because of the shallow rooting system and small size of the stumps, most of them could be pulled by a 2,800-pound team without the use of blocks and line. The stumps that could not be pulled by a team were split by a small charge of dynamite, and the remaining pieces were pulled out by a team. The second growth on this land consisted of poplar and bird cherry. Small logs were numerous. The various items entering into the cost of clearing were not kept separately. The superintendent said that they were approximately as follows:

To cut, pile, and burn brush, per acre	$10.00
To pile and burn logs, per acre	12.00
To pull, pile, and burn stumps, per acre	17.30
Total cost per acre	39.30

TRACT NO. 7.

Tract No. 7 contained 60 acres, principally of heavy clay soil, in a few places having sandy-loam soil with a heavy clay subsoil 6 inches below the surface. The land was nearly free from stones and was gently rolling. The outfit used was a tripod stump puller. This tract had been logged 20 years before. All the stumps were white pine. There was no undergrowth or logs. The tract had been pastured several years and at the time of stumping was covered with a fairly good clover sod.

The sizes of 354 white-pine stumps selected at random and measured on this tract were as follows: 12-inch, 2; 14-inch, 2; 16-inch, 11; 18-inch, 28; 20-inch, 37; 22-inch, 35; 24-inch, 88; 26-inch, 65; 28-inch, 42; 30-inch, 21; 32-inch, 13; 34-inch, 6; 36-inch, 4. The average diameter was 24.6 inches. The average height was 36 inches. The total number of stumps pulled was 2,464, the average per day being 54. The average number per acre was about 41. Details of the cost are given in Table VII. The stumps on this tract were piled in the fall of the year and will be permitted to dry out for about two years before any attempt will be made to burn them.

TABLE VII.—*Cost of stumping tract No. 7.*

Item.	Days employed.	Cost.	
		Per diem.	Total.
Pulling, cleaning, and tipping stumps:			
2 men, 46 days each	92	$1.75	$161.00
2 men with team, 46 days each	92	4.50	414.00
Use of machine	46	1.50	69.00
Piling and burning (estimated)			800.00
Total			1,444.00
Average per acre			24.07
Average per stump			.586

The work of stumping this tract was difficult because of the nature of the soil and size of the stumps. It was done under contract by one of the largest stumping contractors in Michigan. All of the crew were experienced men. The contract price for pulling, cleaning, and tipping the stumps on this tract was $788, or about 32 cents per stump. The actual cost was 26 cents. The average farmer or settler, even though he had the equipment, probably could not do the work as cheaply as it was done by this contractor.

TRACT NO. 8.

Tract No. 8 contained 30 acres of nearly level land with sandy-loam soil. The outfit used was a tripod stump puller. The total number of stumps pulled was 2,464. The average number pulled per day was 137. The average number per acre was about 82. The average diameter per stump was about 24 inches. This work was done under contract at 19 cents per stump for pulling, cleaning, and tipping. The actual cost was 10.2 cents, as shown in Table VIII. The low cost of stumping was largely due to the sandy nature of the soil and the fact that the stumping crew was experienced. These stumps were to be piled and burned later in the year.

TABLE VIII.—*Cost of stumping tract No. 8.*[1]

Item.	Days employed.	Cost.	
		Per diem.	Total.
Pulling, cleaning, and tipping:			
2 men, 18 days each	36	$1.75	$63.00
2 men with teams, 18 days each	36	4.50	162.00
Use of machine	18	1.50	27.00
Piling and burning (estimated)			616.00
Total			868.00
Average per acre			28.93
Average per stump			.352

[1] Tract stumped in the fall of 1912.

TRACT NO. 9.

Tract No. 9 contained 30 acres of nearly level land with sandy-loam soil. The outfit used was a tripod stump puller. The total number of stumps pulled was 2,000. The average number pulled per day was 134. The average number per acre was about 67. The average diameter per stump was about 28 inches. This work was done under contract at 25 cents per stump for pulling, cleaning, and tipping. The actual cost was 10.5 cents, as shown in Table IX.

TABLE IX.—*Cost of stumping tract No. 9.*[1]

Item.	Days employed.	Cost.	
		Per diem.	Total.
Pulling, cleaning, and tipping:			
2 men, 15 days each	30	$1.75	$52.50
2 men with teams, 15 days each	30	4.50	135.00
Use of machine	15	1.50	22.50
Piling and burning (estimated)			500.00
Total			710.00
Average per acre			23.67
Average per stump			.355

[1] Tract stumped in the summer of 1913.

The low cost of stumping was largely due to the sandy nature of the soil and the fact that the stumping crew was experienced. This work was done by the same contractor who stumped tracts Nos. 7 and 8. The stumps were piled and burned later in the year.

TRACT NO. 10.

Tract No. 10 contained 46 acres of nearly level silt-loam to clay-loam soil. In places the tract was very stony; round cobblestones predominated. The outfit used was a tripod stump puller. This tract had been logged 30 years before. The second growth and logs had been previously removed.

The sizes of 114 white-pine stumps selected at random and measured on this tract were as follows: 12-inch, 1; 18-inch, 2; 20-inch, 8; 22-inch, 7; 24-inch, 22; 26-inch, 9; 28-inch, 10; 30-inch, 12; 32-inch, 17; 34-inch, 9; 36-inch, 10; 38-inch, 1; 40-inch, 3; 42-inch, 1; 44-inch, 1; 48-inch, 1. The average diameter was 28.6 inches and the average height 36 inches. The total number of stumps pulled was 1,812. The average number pulled per day was 48. The average number per acre was 39. This work was done under contract at 35 cents per stump for pulling and cleaning. The actual cost of pulling and cleaning was 32 cents per stump, as shown in Table X.

TABLE X.—*Cost of stumping tract No. 10.*[1]

Item.	Days employed.	Cost.	
		Per diem.	Total.
Pulling and cleaning stumps:			
2 men, 37¾ days each	75½	$1.75	$132.12
1 man with team	37¾	4.50	169.88
1 man with 3 horses	37¾	5.85	220.84
Use of machine	37¾	1.50	56.62
Tipping stumps (estimated at 3 cents each)			54.36
Piling and burning (estimated)			650.00
Total			1,283.82
Average per acre			27.91
Average per stump			.71

[1] Tract stumped from June 27 to Aug. 12, 1913.

The work was done by an extensive stumping contractor. The stony ground made digging holes under the roots and cleaning the stumps expensive. The large size of the stumps made their removal costly. The stumps were to be piled later in the year by the use of a log jammer.

TRACT NO. 11.

The operation on tract No. 11 consisted of pulling 1,319 large white-pine and scattering hardwood stumps on silt-loam to clay-loam soil. In places this tract was very stony. The outfit was a tripod stump puller, the same as that used for tract No. 10, which was adjacent. It had been logged 30 years before. All the second growth and logs had been removed. The average size of the stumps was slightly larger than those on tract No. 10. The average number of stumps pulled per day was 37, and the cost was as shown in Table XI.

TABLE XI.—*Cost of stumping tract No. 11.*[1]

Item.	Days employed.	Cost.	
		Per diem.	Total.
Pulling and cleaning stumps:			
2 men, 35.6 days each	71.2	$1.75	$124.50
1 man with team	35.6	4.50	160.20
1 man with 3 horses	35.6	5.85	208.26
Use of stump puller	35.6	1.50	53.40
Dynamite (40 per cent strength), 500 pounds, at 13 cents			65.00
Caps and fuse			2.51
Piling and burning (estimated)			450.00
Total			1,063.87
Average per stump			.806

[1] Time of stumping, Aug. 12 to Sept. 26, 1913.

A small charge of dynamite was placed under the larger stumps in order to split and loosen them. In commenting on the use of dynamite here, the contractor said: "This is the only job in my seven years of stumping where it would pay to use dynamite under nearly every stump." The owner of this tract had previously used dynamite in stumping on his land.

TRACT NO. 12.

Tract No. 12 contained 40 acres of nearly level land with sandy-loam soil. The outfit was the same as for tract No. 11. The total number of stumps pulled was 2,400. The total number of stumps per acre was 60. The average number of stumps pulled per day was 100. The stumps averaged somewhat smaller than in the two preceding tracts, and the soil was sandy loam and free from stones. This work was done at a contract price of 18 cents per stump for pulling, cleaning, and tipping. The actual cost was 14 cents per stump, as shown in Table XII.

TABLE XII.—*Cost of stumping tract No. 12.*[1]

Item.	Days employed.	Cost.	
		Per diem.	Total.
Pulling, cleaning, and tipping stumps:			
2 men, 24 days each	48	$1.75	$84.00
2 men with teams, 24 days each	48	4.50	216.00
Use of machine	24	1.50	36.00
Piling and burning (estimated)			432.00
Total			768.00
Average per acre			19.20
Average per stump			.32

[1] Stumped in the spring of 1913.

TRACT NO. 13.

Tract No. 13 contained 20 acres of practically level pasture land having a sandy, and in places a gravelly, surface soil. The subsoil was generally below root depth. This land had been logged 25 years before. There were no logs or underbrush. The outfit used was a tripod stump puller.

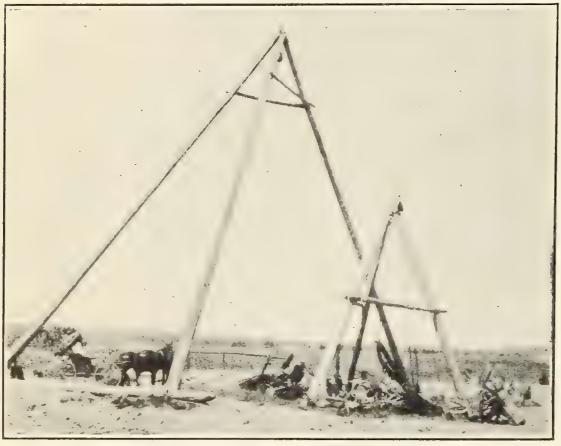

FIG. 10.—Tripod stump piler (at left) and tripod stump puller (at right).

Stumps to the number of 1,293 were pulled, piled, and burned at a contract price of $500, or 38.7 cents per stump. By means of the tripod piler shown in figure 10 all these stumps were put into four piles. The stumps were pulled in November, 1912.

The sizes of 98 white-pine stumps selected at random and measured on this tract were as follows: 12-inch, 6; 14-inch, 8; 16-inch, 8; 18-inch, 5; 20-inch, 10; 22-inch, 16; 24-inch, 16; 26-inch, 11; 28-inch, 5; 30-inch, 8; 32-inch, 2; 34-inch, 1; 38-inch, 2. The average diameter was 23.2 inches.

Several other owners in this neighborhood had contracted to have stumps pulled, cleaned, and tipped for 25 cents each. The general clearing conditions on these contracts were the same as for tract No. 10.

TRACT NO. 14.

Tract No. 14 contained 7.4 acres of very gently rolling pasture land, having a loose, sandy-loam soil. The outfit used was a tripod

machine mounted on two wheels. This tract had been logged 45 years before. There were no logs or underbrush.

The sizes of 98 white-pine stumps selected at random and measured on this tract were as follows: 16-inch, 7; 18-inch, 10; 20-inch, 3; 22-inch, 9; 24-inch, 15; 26-inch, 14; 28-inch, 8; 30-inch, 6; 32-inch, 7; 34-inch, 4; 36-inch, 6; 38-inch, 3; 40-inch, 1; 42-inch, 4; 48-inch, 1. The average diameter was 26.77 inches.

The high cost of stumping this tract, shown in Table XIII, was principally due to the inexperience of the contractor and crew and to the fact that only one light team was used. The contract price for pulling, cleaning, and tipping the stumps was 50 cents each. The actual cost was 56.3 cents. The owner of the tract was utilizing the roots for fuel. The total number of stumps was 204 and the number per acre 28. The number pulled per day was 15.

TABLE XIII.—*Cost of stumping tract No. 14.*[1]

Item.	Days employed.	Cost.	
		Per diem.	Total.
Pulling, cleaning, and tipping:			
1 boy	13¼	$1.00	$13.25
1 man	13¼	1.75	22.19
1 man with team	13¼	4.50	59.62
Use of machine	13¼	1.50	19.87
Piling and burning (estimated)			70.00
Total			184.93
Average per acre			25.05
Average per stump			.907

[1] Time of stumping, July 19 to Aug. 8, 1913.

TRACT NO. 15.

Tract No. 15 contained 40 acres of very gently rolling land, having a sandy soil. The clearing was done in the spring of 1912. The outfit consisted of a tripod stump puller, two teams, and five men. This outfit and crew pulled 2,132 stumps in 20½ days, an average of 104 stumps per day. This tract had an average of 90 stumps per acre, of which 20 were Norway pine and 70 were white pine.

The clearing was done at a contract price of $30 an acre. The price included the delivery of the Norway-pine stumps to a turpentine plant 3 miles distant from the tract, the hauling of nearly one-third of the white-pine stumps to build fences, and the burning of the remainder of the white-pine stumps. The Norway-pine stumps had been burned to the surface of the ground on nearly 10 acres of this tract. A total of 60 cords of Norway-pine stumps was delivered at the plant. The price received was $5 per cord of 4,000 pounds. It took an average of 10 Norway-pine stumps to the cord. Two cords of stumps per acre were obtained. After deducting the amount received for the stumps, the net cost of clearing the tract was $900,

or $22.50 per acre. The contractor still considers $30 a fair price, but owing to circumstances and bad weather wages were not made upon this work.

In another case in this neighborhood the owner of 640 acres of land gave all the Norway-pine stumps on it for the clearing of 15 acres ready for the plow.

TRACT NO. 16.

On a tract of 35 acres of nearly level land, having a sandy-loam surface soil and a clay subsoil, which had been logged 30 years before, 1,050 white-pine stumps, averaging 26 inches in diameter, were pulled with a tripod machine at a contract price of 33⅓ cents per stump for pulling, cleaning, and tipping.

TRACT NO. 17.

On another tract of 105 acres of nearly level land, having a sandy-loam surface soil and a clay subsoil averaging 18 inches below the surface, which had been logged 25 to 40 years before, 7,000 white-pine stumps, averaging 22 inches in diameter, were pulled with a tripod machine at a contract price of 25 cents per stump for pulling, cleaning, and tipping. These stumps were hauled into fence rows for 18 cents per stump, contract price.

TRACT NO. 18.

On a tract of 10 acres of gently rolling land having a sandy and gravelly loam surface soil and in places a clay subsoil, which had been logged 25 years before, 600 white-pine stumps, averaging 18 inches in diameter, were pulled with a tripod machine at a contract price of 30 cents each for pulling, cleaning, and tipping.

TRACT NO. 19.

On an adjoining tract of 16 acres, with soil the same as in tract No. 18, and using the same outfit, 330 stumps were pulled, cleaned, and tipped for 30 cents each. The contractor took both jobs at a flat rate of 30 cents per stump.

TRACT NO. 20.

Tract No. 20 contained 18 acres of cedar-swamp land that had been very severely burned in 1908 and 1911. The soil varied from a clay loam to a heavy clay. Practically all the roots had been burned off. The stumps rested on top of the ground. One horse could easily pull nearly every stump on this tract. The few stumps that were too firmly rooted to be pulled by a horse were loosened by the use of dynamite. The number of trees and stumps per acre on adjoining similar tracts was about 300. The stumping and part of the piling was done from July 15 to October 1, 1912. The remainder of the piling and all of the burning was done after April 12, 1913. The work of clearing was thorough. The details of cost are shown in Table XIV.

TABLE XIV.—*Cost of labor and material used in clearing tract No. 20.*

Item.	Days employed.	Cost.	
		Per diem.	Total.
Stumping and piling:			
1 man as laborer and driver	60	$1.75	$105.00
1 man as laborer and powder man	60	1.75	105.00
1 horse	60	1.25	75.00
Total labor cost			285.00
Dynamite (40 per cent strength), 50 pounds, at 20 cents			10.00
Fuse and caps			.75
Burning stumps and completing clearing:			
1 man	18	1.75	31.50
1 man with team	18	4.25	76.50
Total			403.75
Average cost per acre			22.43

This swamp clearing is typical of the cost of clearing much of the severely burned swamp land of Cheboygan and Presque Isle Counties, Mich.

DISPOSAL OF STUMPS AFTER PULLING.

Where medium-sized stumps have been well blasted the problem of stump disposal is relatively simple. It is considered cheaper to start several small, conveniently located fires in the holes made by blasting the stumps and then haul the remaining pieces to these fires than it is to build a few large piles and not set them on fire until all the stumps are piled. Where the stumps have been pulled by a stump puller without the use of powder the problem of disposal is more difficult. The general opinion throughout this region is that the cost of disposal practically equals the expense of pulling. All data secured seem to verify the accuracy of this estimate. In the early days of clearing, the stumps were hauled into rows to serve as fences. At the present time very few such fences are being built. The usual contract price for hauling stumps into fences is 15 to 18 cents each.

PILING STUMPS.

Large stumps are very hard to pile. Some owners split the stumps by the use of a small charge of dynamite placed either in a hole bored into the base of the stump or in a notch chopped between two prominent roots. Often the heart of the stump is sufficiently decayed so that the charge may be placed in it. A small quantity of dynamite used in this manner will usually split the stump as well as a much larger charge would have done before the stump was pulled.

By using a tripod, such as is shown in figure 10, with legs 40 or 45 feet long and equipped with a double block and 150 feet of half-inch cable, the stumps can be piled 25 or 30 feet high. This tripod was used on tract No. 13. Another good method of piling is to use

a piler with a swinging boom, as shown in figure 9. The mast of this piler is 30 feet high and the swinging boom 25 feet long. In using this boom piler the mast is set so that it leans slightly toward the pile. This causes the boom to swing to the center each time. This piler was used in clearing tract No. 5. Dropping stumps into a fire by means of piling devices is impracticable, because the heat soon becomes so intense that the piling operations must be abandoned.

The work of piling stumps could be hastened materially if some satisfactory tripping device could be used. The usual self-tripping tongs and rope trips frequently catch on projecting roots and drop the load before it is at the desired position.

OTHER WAYS OF DISPOSING OF STUMPS.

In the past a considerable number of Norway-pine stumps have been used by turpentine manufacturers for distillation. The present low price of turpentine and naval stores has made the distillation of Norway-pine stumps unprofitable, and none of the turpentine plants are now in operation. The white-pine stump contains too small a quantity of the properties of the Norway-pine stump to make it of any value.

SUMMARY AND SUGGESTIONS.

There are approximately 11,954,628 acres of logged-off land in Michigan, 10,792,100 acres in Wisconsin, and 11,768,000 acres in Minnesota. A large part of this area will make good agricultural land if cleared and properly managed. In many localities poor methods make the clearing of this land unprofitable. Cutting and burning the second growth pasturing for several years, and keeping down all sprout growth is the most economical method of handling all logged-off lands before stumping them. Explosives play an important part in clearing land. On the heavier soils dynamite, with 20 to 30 per cent of nitroglycerin or its equivalent, is to be preferred. Cooperative buying in large quantities is recommended. Stump pullers reduce the cost of stumping on lighter soils. On the heavier soils the difference between the cost of clearing by explosives and by the use of stump pullers is very slight.

The cost of clearing the better grade of white-pine logged-off land will average $10 per acre for disposing of the brush and $25 to $30 per acre for disposing of the stumps, making the cost of clearing $35 to $40 per acre. Some green hardwood lands and unburned swamp lands will cost as much as $100 per acre. Some of the poorer jack-pine lands can be cleared for $5 per acre or less.[1] The cost of disposing of the stumps after pulling practically equals the cost of pulling.

[1] Those contemplating farming the jack-pine lands are urged to study Smith, C. Beaman, Clover farming on the sandy jack-pine lands of the North, U. S. Department of Agriculture, Farmers' Bulletin 323, 24 p., 1 fig., 1908.

A tripod or a boom piler is recommended to facilitate piling and burning.

The settler with little capital and without experience who expects to make a farm out of a tract of logged-off land will find his problem a most trying one. The experiences of those who have attempted it are not encouraging. The man who starts farming with even 10 acres of his farm cleared will be much more likely to succeed than the man who begins on a tract covered with second growth and stumps. The former will have land on which to grow hay and other crops the first year. He can devote his extra time the first three or four years to the disposal of the second growth on the remainder of his tract. By seeding this, he will increase the area of his pasture or hay land materially and will be employing the best preparatory means of reducing the cost of stumping later. The settler should not forget that the cheapest and best land clearing is always done by experienced men with proper equipment.

For these reasons it is recommended that, in all localities where land companies are selling lands to settlers, no tract of land be sold unless it contains at least 10 acres of land cleared ready for the plow.

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